ABSTRACT OF THE DISCLOSURE

Rechargeable electrochemical cells, such as lithium batteries and asymmetric hybrid battery/supercapacitor systems, exhibiting exceptional specific capacity levels and stability over extended high-rate recharge cycling comprise nanostructure zero strain $Li_4Ti_5O_{12}$ intercalation electrode material synthesized in a short duration process of annealing mixed TiO_2 and Li-source precursor compounds at about 800°C for a time of about 15-30 min which is not substantially longer than that required to effect maximum available reaction between the precursors, thereby substantially eliminating the growth of synthesized $Li_4Ti_5O_{12}$ particles beyond nanostructure size. The process reduces by order of magnitude the time and energy required for synthesis of the active electrode material and fabrication of utilizing cell devices, and provides such nanostructure material which enables repeated, high-rate recharge cycling without loss of cell capacity or efficiency.